MET Update

- **What is wrong with MET?**
- **New met_analyze package**
- **Old vs New MET variable sets**
- **Rough sketch of new MET object**
- **MET reference plots (p10.11.00)**

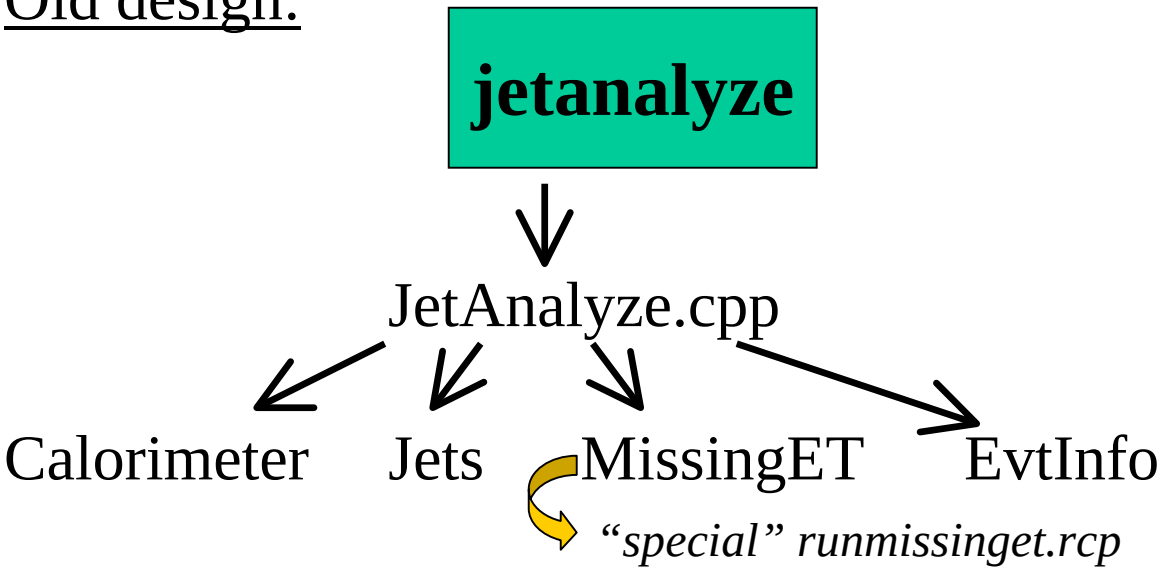
Alan L. Stone - Louisiana Tech University

Why Change MET?

- **It's a Hack!**
  - **More Fortran & C-like than object-based**
- **At least 8 "authors" in five years**
  - **Different & uncoordinated style**
- **Need to modify *jetanalyze* to capture changes to MissingET object…**
- **Only one object is used!**
  - **Structure is too rigid**
  - **PMCS copy constructor**
  - **Adding variable(s) →too complicated**
- **Confusing variable names**
  - **What does METNE or MEyWE mean?**
- **More variables needed for analyses**

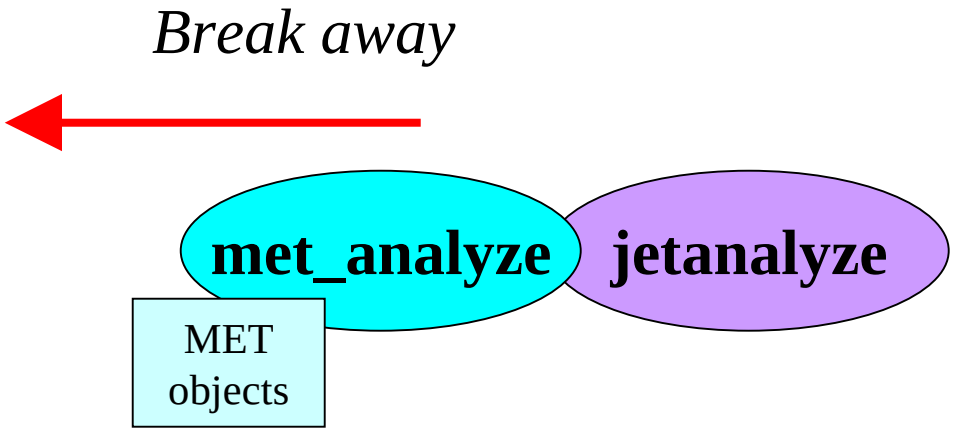
New met_analyze package

Old design:



analyze	bcjet_analyze
bphys_analyze	caep_analyze
cal_nada_analyze	calanalyze
chpart_analyze	d0_analyze
em_analyze	fe_crate_analyze
fps_analyze	gtr_analyze
jetanalyze	l1cal_analyze
l1frm_analyze	l1ft_analyze
l1muo_analyze	l2calem_analyze
l2caljet_analyze	l2calmet_analyze
l2cps_analyze	l2cttcft_analyze
l2gbl_analyze	l2gblem_analyze
l2mu_analyze	l2stt_analyze
l3fanalyze	l3fsmtanalyze
l3fvertex_analyze	l3prop_analyze
mc_analyze	mccomb_analyze
met_analyze	muo_analyze
nada_analyze	prop_analyze
reco_analyze	semanalyze
smt_analyze	tau_analyze
trig_jetanalyze	trigsim_analyze
vertex_analyze	wz_analyze

New design:



Date: Thu, 06 Dec 2001 13:31:55 -0600
From: Alan M Jonckheere <jonckheere@fnal.gov>
Subject: Re: Package request: met_analyze

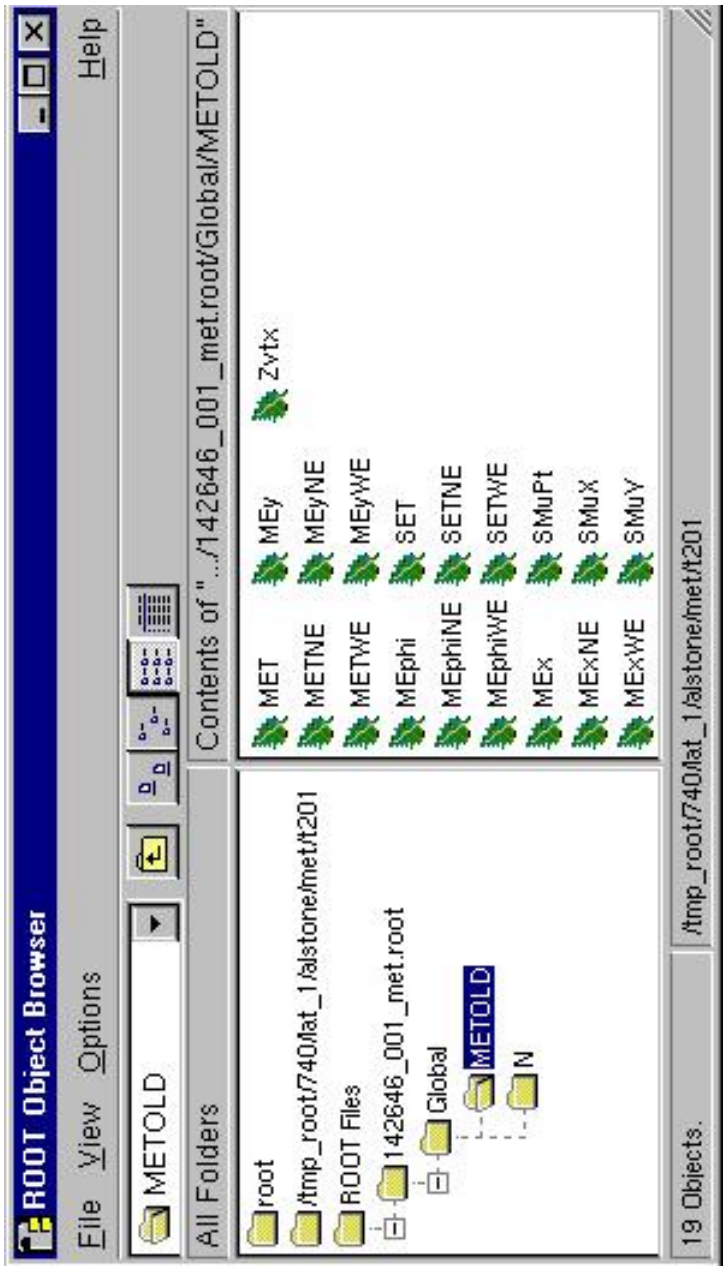
done. NOTE: to have an exe stay around after a release is "frozen", you need to ask that it be saved (we get rid of >10GB of "junk" per build (5/10 builds per week) by cleaning out unasked for exes. I need: exe name *exact* + short (< 1 line) description of what it does.
Alan

> Hi Alan,
>
> Package name: met_analyze
> Package purpose: METAnalyze would be the framework package that produces an Ntuple for
> missingET. This is currently done in JetAnalyze. The Jets/MET convenors and I have
> agreed that it makes sense to separate missingET from JetAnalyze.
> Authors: Alan L. Stone - alstone@fnal.gov
> Joe Steele - steele@fnal.gov
> Lee Sawyer - sawyer@fnal.gov
> thanks, alan

METOLD block (during the transition period)

Calculated from towers in CalData chunk

MET	**Missing Et Calorimeter only**
METx	**x component of MET – Cal only (can be negative)**
METy	**y component of MET – Cal only (can be negative)**
MEphi	**METx/METy**
SET	**Scalar ET**
METNE	**Same as MET with threshold of 200 MeV/tower**
METNEx	**Same as METx w/threshold of 200 MeV/tower**
METNEy	**Same as METy w/threshold of 200 MeV/tower**
MEphiNE	**METNEx/METNEy**
SETNE	**Same as SET w/threshold of 200 MeV/tower**
METWE	**Same as METNE with |iη|<33**
METWEx	**Same as METNEx with |iη|<33**
METWEy	**Same as METNEy with |iη|<33**
MEphiWE	**METWEx/METWEy**
SETWE	**Same as SETNE with |iη|<33**
Zvtx	**primary reconstructed Z position of vertex**
SMuX	**px sum of the "good muons"**
SMuY	**py sum of the "good muons"**
SMuPt	**Transverse momentum of the "good muons"**



New MET Variable Scheme

- Only one MET object is needed - instantiated several times
  - Towers
    - Cal + ICD
    - Cal only
    - eta limits
    - tower energy thresholds
  - Cells
    - Cal + ICD
    - ICD only
    - eta limits
    - cell energy thresholds
    - NADA
- Separate object for muon info
- Separate object for PMCS
- Separate object for Rings
- Missing E_T RECO gets list or vector of MET objects
- met_analyze ➡ new variables are filled
  - muon correction done here

Date: Mon, 19 Nov 2001 23:00:25 +0100 (CET)
From: Gregorio Bernardi <gregorio@in2p3.fr>
To: d0jetmet@fnal.gov
Subject: Upgrade of the MET Block/scheme.

SET: scalar ET obtained as the sum of cell energy*abs(sin(theta)).
a cell with negative energy will give a NEGATIVE contribution to SET

VETx: x of vect. ET obtained as the sum of the cell energy*sin(th)*cos(ph)
VETy: y of vect. ET obtained as the sum of the cell energy*sin(th)*sin(ph)
VETz: z of vect. ET obtained as the sum of the cell energy*cos(th)
(in these 3 variables the energy can be positive or negative)

VET=sqrt(VETx2+VETy**2)**

the x and y component of the Missing ET (METx, METy) are simply:
METx=-VETx
METy=-VETy

the missing transverse energy is obtained by
MET=sqrt(METx2+METy**2) , and of course MET=VET.**

in the detailed variables, we use VETx, VETy, VETz in order to have a symmetric (same sign) treatment of calorimeter and muons:
e.g. VETx=+VETCALOx+VETMUONx, etc..

Structure of the future MET block

Global variables:

SETT Scalar Et constructed from Cal-ICD Towers (=+SETTAS +SETTBS)
METTx x component constructed from Cal-ICD Towers (=-VETTASx-VETTBSx)
METTy y component constructed from Cal-ICD Towers (=-VETTASy-VETTBSy)
METT Missing Et constructed from Cal-ICD Towers

METTM Scalar Et constructed from Cal-ICD Towers&Muon (+SETT +SETMUON)
METTMx x component constructed from Cal-ICD Towers&Muon (-VETTx-VETMUONx)
METTMy y component constructed from Cal-ICD Towers&Muon (-VETTy-VETMUONy)
METTM Missing Et constructed from Cal-ICD Towers&Muon

SETC Scalar Et constructed from Cal-ICD Cells (+SETCAS +SETCBS)
METCx x component constructed from Cal-ICD Cells (-VETCASx-VETCBSx)
METCy y component constructed from Cal-ICD Cells (-VETCASy-VETCBSy)
METC Missing Et constructed from Cal-ICD Cells

SETCM Scalar Et constructed from Cal-ICD Cells&Muon (+SETC +SETMUON)
METCMx x component constructed from Cal-ICD Cells&Muon (-VETCx-VETMUONx)
METCMy y component constructed from Cal-ICD Cells&Muon (-VETCy-VETMUONy)
METCM Missing Et constructed from Cal-ICD Cells&Muon

SETTAS Scalar sum of Towers Above eta limit and E_tow > twr-thresh.
VETTASx Vectorial sum of Towers Above eta limit and E_tow > twr-thresh.
(the x,y,z components are given, same for all variables below)

SETTBS Scalar sum of Towers Below eta limit and E_tow > twr-thresh.
VETTBSx Vectorial sum of Towers Below eta limit and E_tow > twr-thresh.

TOWERS

SETTAN Scalar sum of Towers Above eta limit and E_tow < twr-thresh.
VETTANx Vectorial sum of Towers Above eta limit and E_tow < twr-thresh.

SETTBN Scalar sum of Towers Below eta limit and E_tow < twr-thresh.
VETTBNx Vectorial sum of Towers Below eta limit and E_tow < twr-thresh.

SETCAS Scalar sum of Cells Above eta limit and E_cell > cel-thresh.
VETCASx Vectorial sum of Cells Above eta limit and E_cell > cel-thresh.

CELLS

SETCBS Scalar sum of Cells Below eta limit and E_cell > cel-thresh.
VETCBSx Vectorial sum of Cells Below eta limit and E_cell > cel-thresh.

SETCAN Scalar sum of Cells Above eta limit and E_cell < cel-thresh.
VETCANx Vectorial sum of Cells Above eta limit and E_cell < cel-thresh.

SETCBN Scalar sum of Cells Below eta limit and E_cell < cel-thresh.
VETCBNx Vectorial sum of Cells Below eta limit and E_cell < cel-thresh.

Standalone part

SETICD Scalar sum of ICD cells only
VETICDx Vectorial sum of ICD cells only

SETNADAx Scalar sum of NADA cells
VETNADAx Vectorial sum of NADA cells

SETMUONx Scalar sum of MUONs
VETMUONx Vectorial sum of MUONs

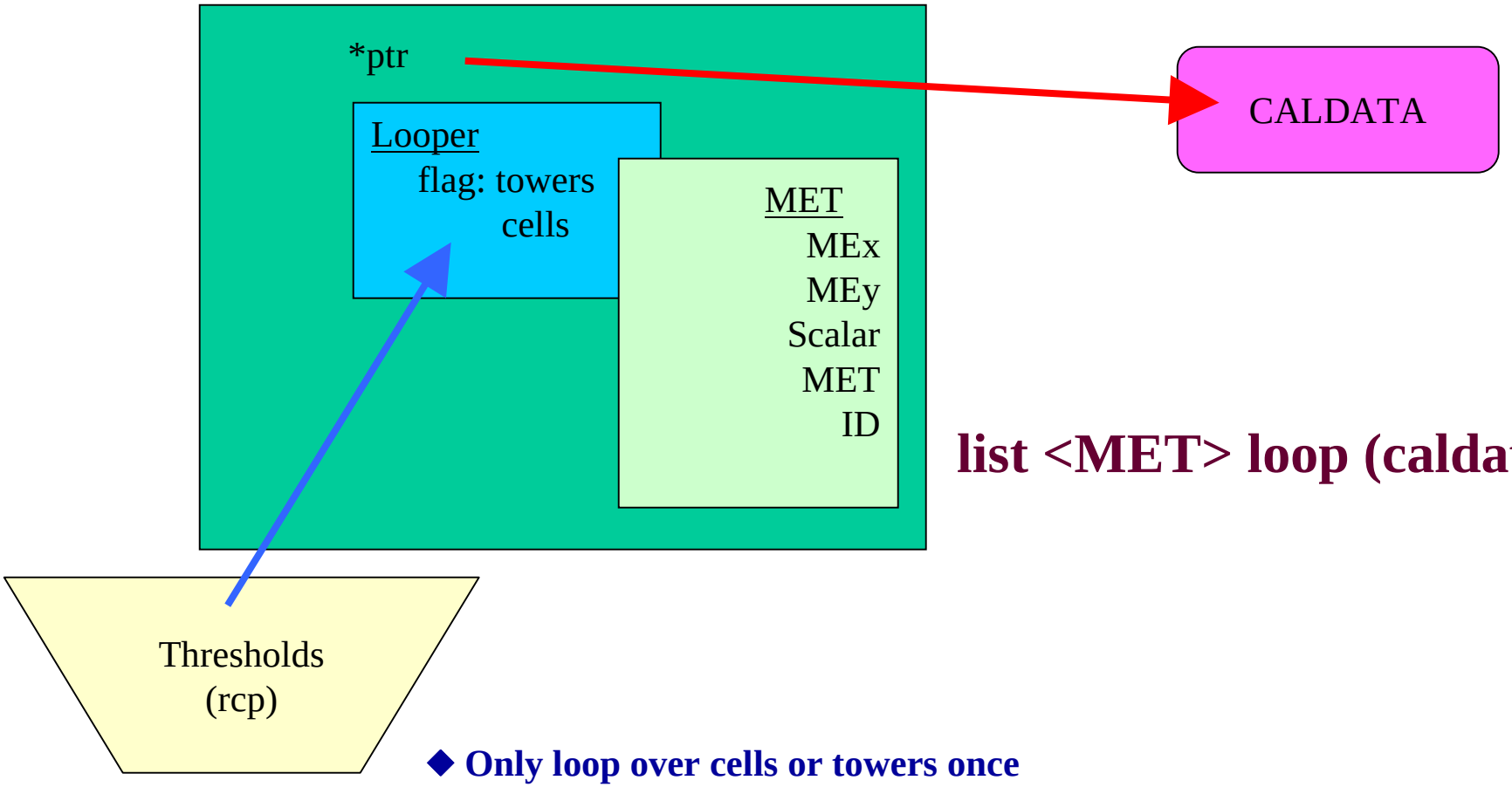
The .....N,ICD,NADA, quantities are given for systematic studies.
They are not used explicitely in the global MET/SET calculations done in this block, since the ICD is already included in the Tower and Cells variables, and since NADA hot cells have already been suppressed.
However, if NADA is ran in shadow mode then the NADA quantities can be used to obtain a NADA corrected missing/Scalar ET. Conversely, if NADA has been run in killing mode, the non-NADA corrected MET can be trivially restored using the detailed NADA variables.

The revertexing block corresponds to the VETTAS+VETTBS quantities.
(i.e the total vectorial E_T obtained from towers above tower threshold).

The WE/NE concept of the old MET block is implemented in this scheme by the 2 complementary quantities:
SETTAS (towers above eta limits) SETTBS (towers below eta limit),
i.e. SETT=SETTAS+SETTBS (similary for VETx,y,MET).

Rough Sketch of New MissingET

[thanks to Laurent Duflot & Harry Melanson]



list <MET> loop (caldata*)

- **Only loop over cells or towers once**
- **Calorimeter cell occupancy is about 5% per event (Total #Cells ~47k)**
- **Calorimeter Event Readout : #Cells ~ 2x #Towers**

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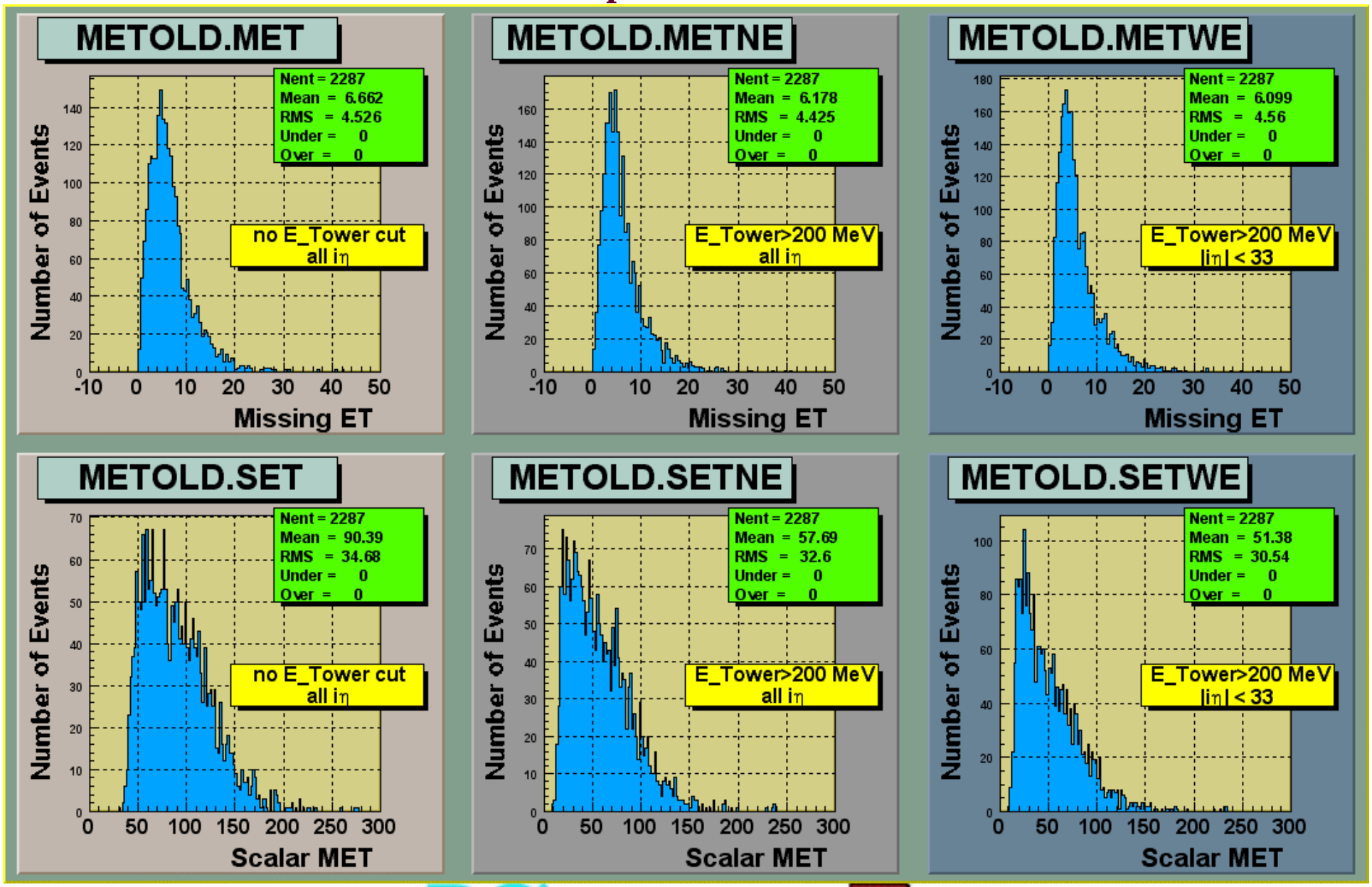

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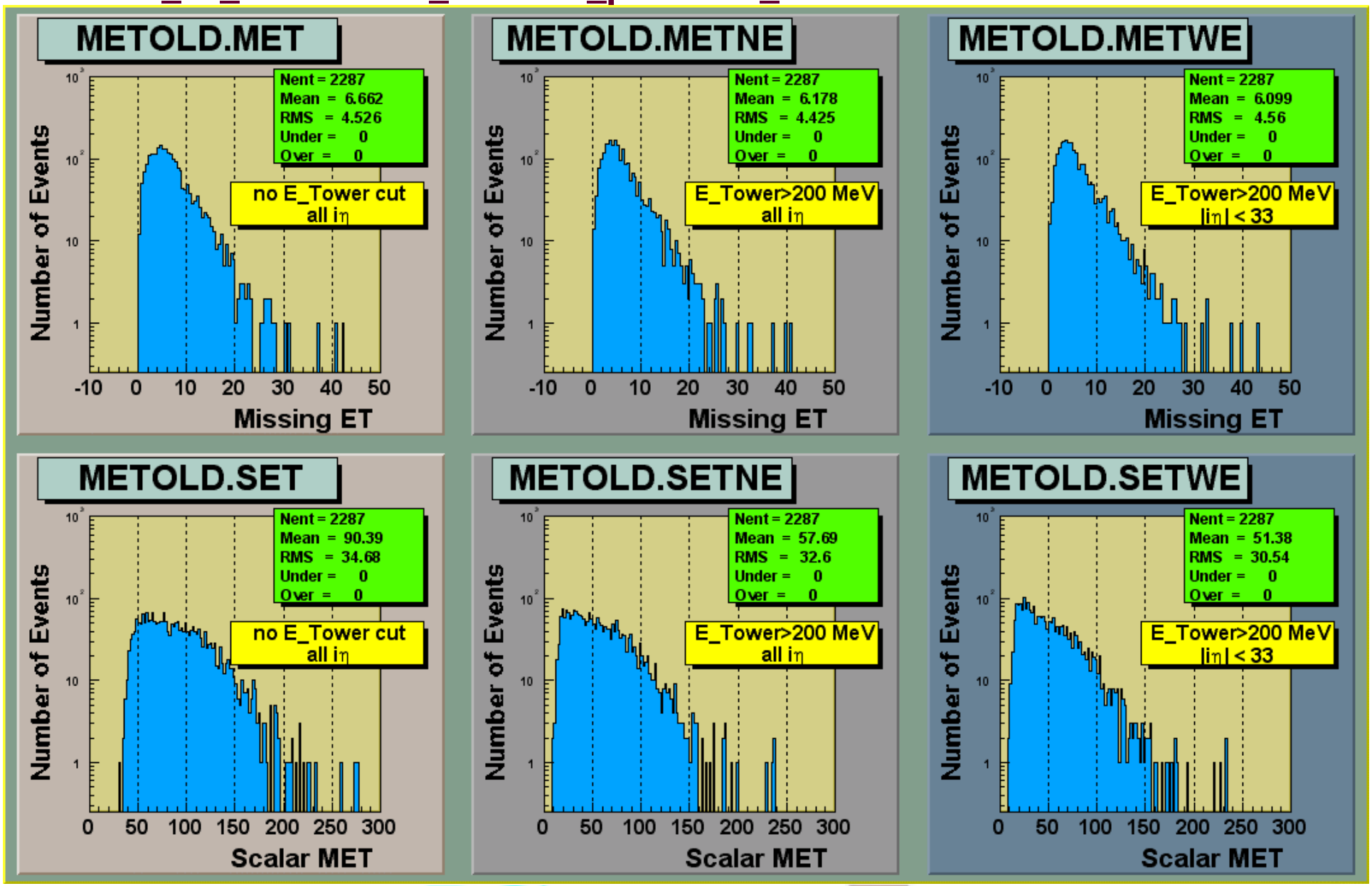

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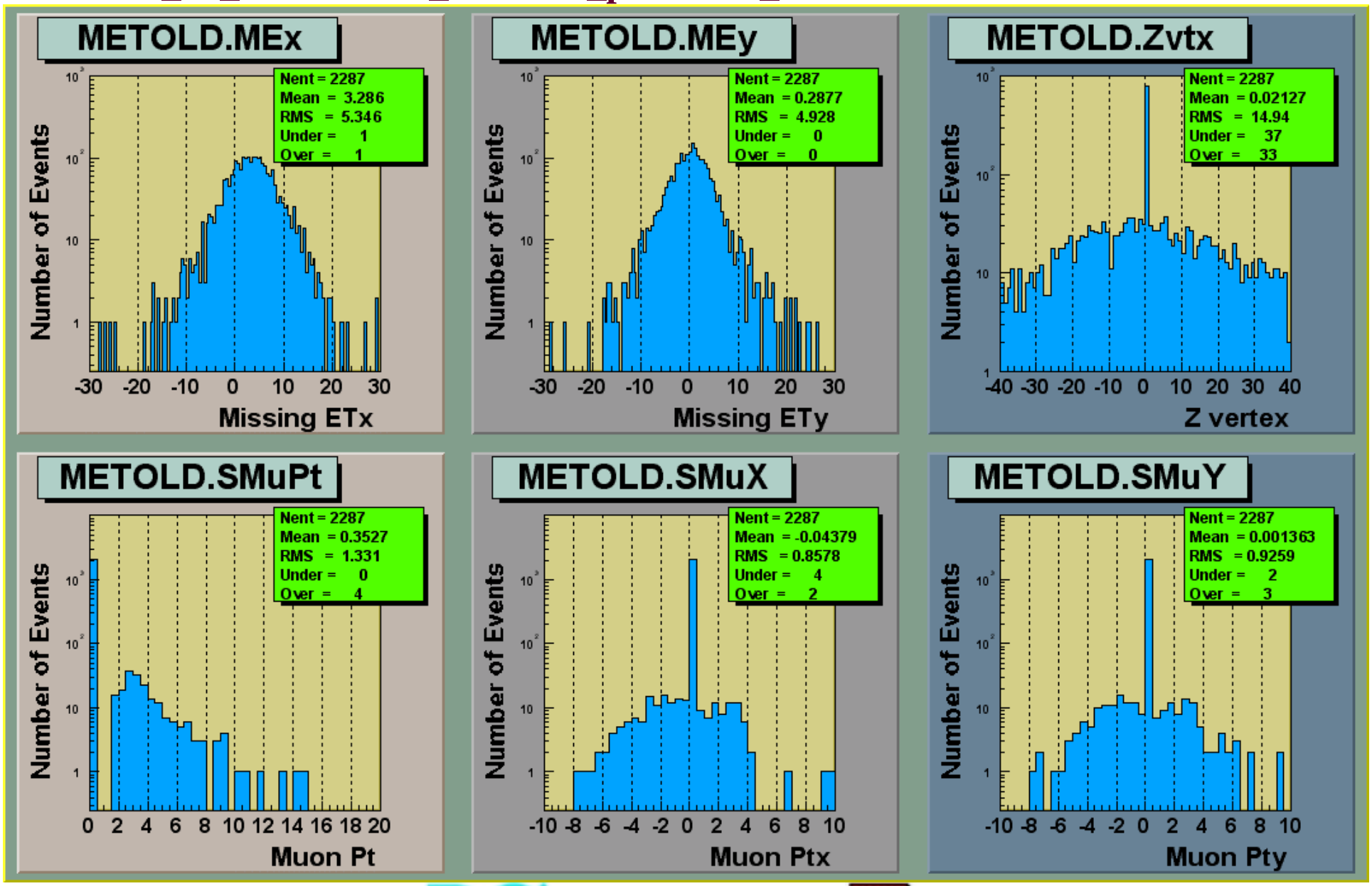

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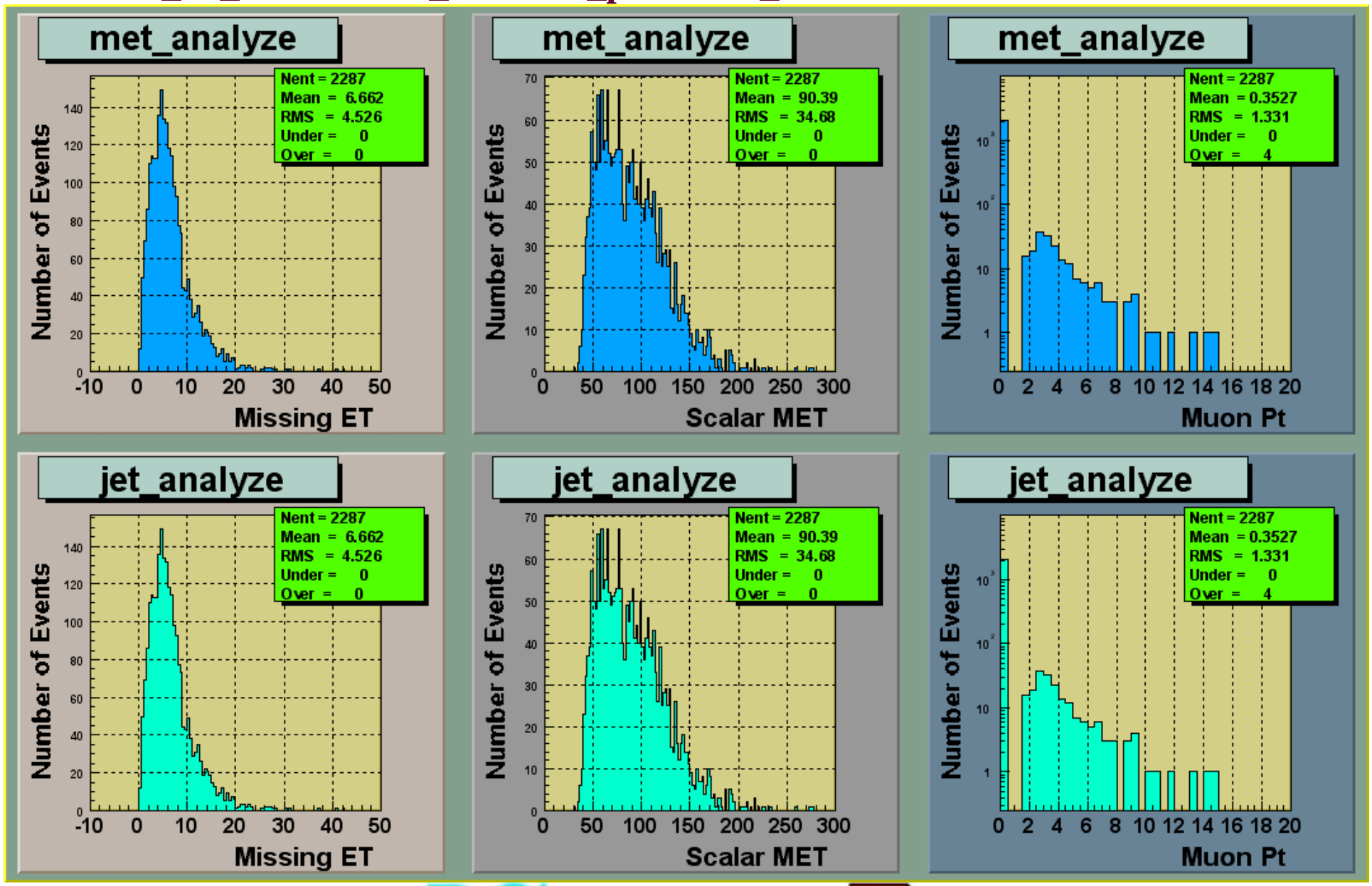

What's Next?

- Add new MET block to ***met_analyze***
  - Keep METOLD block for transition period
- Write algorithms to calculate MET objects
  - Use old MissingET class initially
    - Important to make new variables available and correct in root-tuple & to facilitate analyses
  - Create, test & release new MET classes
    - In theory very few people should notice when old MissingET code is broken as the MET chunk will be unchanged
- Strip METOLD block from jetanalyze and met_analyze
- Determine if MET calculated from towers **AND** cells is necessary

Reco_all_0000142646_001.raw_p10.11.00_000

Number cells in CalDataChunk = 2939
Sum cell METx = 4.38234
Sum cell METy = -5.36484
Sum cell SET = 198.872
Sum cell MET = 6.92722
Number towers in CalDataChunk = 1290
Sum tower METx = 4.25232
Sum tower METy = -5.49278
Sum tower SET = 190.834
Sum tower MET = 6.94643

Number cells in CalDataChunk = 1792
Sum cell METx = 9.92163
Sum cell METy = -7.81163
Sum cell SET = 97.138
Sum cell MET = 12.6278
Number towers in CalDataChunk = 787
Sum tower METx = 10.042
Sum tower METy = -7.92104
Sum tower SET = 88.8408
Sum tower MET = 12.7901

Number cells in CalDataChunk = 2077
Sum cell METx = 5.55966
Sum cell METy = 7.82454
Sum cell SET = 135.817
Sum cell MET = 9.59861
Number towers in CalDataChunk = 1023
Sum tower METx = 5.11913
Sum tower METy = 7.47021
Sum tower SET = 130.597
Sum tower MET = 9.05591

Number cells in CalDataChunk = 2517
Sum cell METx = -0.699711
Sum cell METy = -2.25492
Sum cell SET = 180.589
Sum cell MET = 2.36099
Number towers in CalDataChunk = 1142
Sum tower METx = -1.51435
Sum tower METy = -2.18183
Sum tower SET = 174.576
Sum tower MET = 2.65587

Number cells in CalDataChunk = 2524
Sum cell METx = 14.0922
Sum cell METy = 4.2117
Sum cell SET = 121.14
Sum cell MET = 14.7081
Number towers in CalDataChunk = 1094
Sum tower METx = 14.274
Sum tower METy = 4.11661
Sum tower SET = 113.853
Sum tower MET = 14.8558

Number cells in CalDataChunk = 1661
Sum cell METx = 9.35186
Sum cell METy = 8.37252
Sum cell SET = 113.495
Sum cell MET = 12.5521
Number towers in CalDataChunk = 821
Sum tower METx = 9.08361
Sum tower METy = 8.56578
Sum tower SET = 106.381
Sum tower MET = 12.4854